

New Chemical Kinetics Approach for DSMC Applications to Nonequilibrium Flows, Phase I

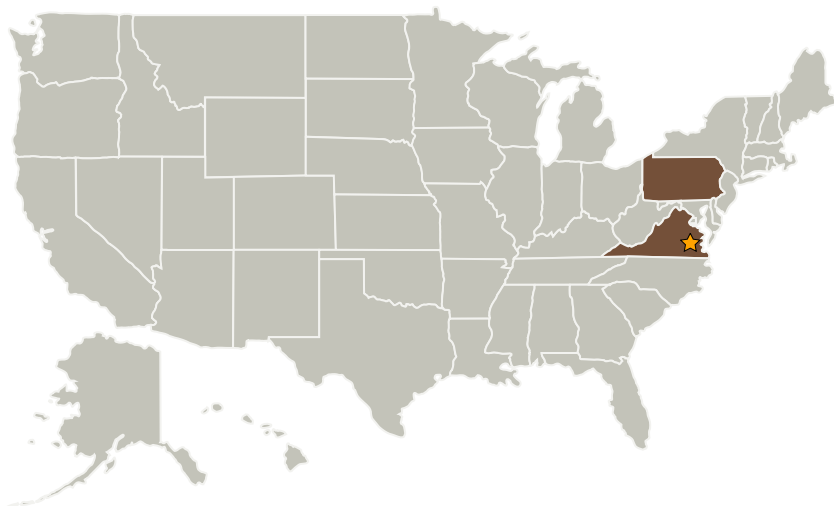
Completed Technology Project (2008 - 2008)



Project Introduction

A new chemical kinetics model and database will be developed for aerothermodynamic analyses on entry vehicles. Unique features of this model include (1) the ability to model chemical kinetics in highly nonequilibrium flows at high altitudes, (2) the ability to predict nonequilibrium dissociation without reliance on traditional continuum kinetic rate equations, and (3) the ability to model complex reactions from fundamental molecular quantum models. The model will permit analyzing high-speed, nonequilibrium flows about entry and aeroassist vehicles based on extensions to Direct Simulation Monte Carlo (DSMC) codes, and a new database will be developed for these extensions. The new approach offers potential for treating other complex nonequilibrium flow physics including ionization and radiation in a more direct manner than has been previously used and therefore offers potential improvements in accuracy. These tools will provide essential data for assessing the aerothermodynamic performance of a broad variety of vehicle designs over a wide range of vehicle attitudes and flight conditions. The improved accuracy offered by our proposed chemical kinetic modeling approach provides significant benefits in the design of vehicles for both unmanned planetary missions and manned missions to the Moon and Mars.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★ Langley Research Center (LaRC)	Lead Organization	NASA Center	Hampton, Virginia
CRAFT Tech - Combustion Research and Flow Technology	Supporting Organization	Industry	Pipersville, Pennsylvania

Primary U.S. Work Locations	
Pennsylvania	Virginia

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Richard G Wilmoth

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - └ TX15.1 Aerosciences
 - └ TX15.1.2 Aerothermodynamics